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(54) Title: MEDIA SERVER FOR SUPPLYING VIDEO AND MULTI-MEDIA DATA OVER THE PUBLIC TELEPHONE SWITCHED NETWORK
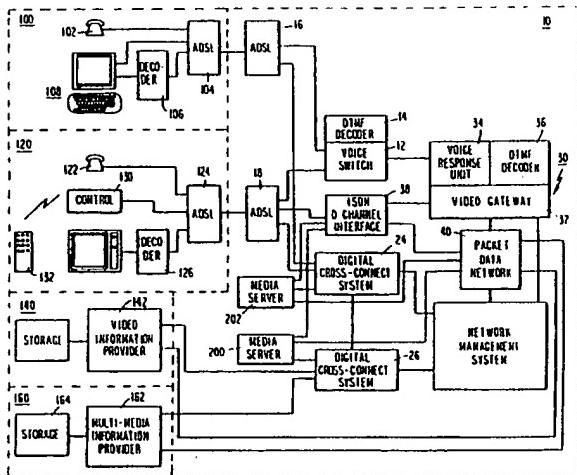
(57) Abstract

A media server (200, 202) receives, stores and forwards multi-media data and full motion video feature presentations within a PSTN. The media server (200, 202) receives wide band digital video and MPEG encoded video signals. The wide band digital video is encoded using either a real time MPEG encoding for immediate transmission over network facilities to subscribers (100, 120) or using a multi-pass MPEG encoder for storage by the Media Server (200, 202) for subsequent transmission. The Media Server (200, 202) includes DRAM (278), optical and magnetic disk storage (282), high speed tape storage (286) and archival storage (290). A Librarian Processor (250) allocates storage space on a media appropriate to retrieval requirements for the video data. The Librarian is responsive to a storage Manager Processor (270) and a Session Manager Processor (310) for providing video program data to an Output Controller (330).

MEDIA SERVER FOR SUPPLYING VIDEO AND MULTI-MEDIA DATA OVER THE PUBLIC TELEPHONE SWITCHED NETWORK

Technical Field

The invention relates to a data storage distribution system using the Public Switched Telephone Network (PSTN), and, more particularly, to a media
5   server for supplying stored image, video and audio data to local subscribers over a PSTN.

Background Art

Video programming options have experienced rapid growth with advances in communications technology.
10   Recent trends have been directed to user definition of programming, with each system subscriber specifying the programming to be provided. Such a system is described in related co-pending application Serial No. 07/766,535.
15   In addition to conventional full-motion video programs, advances in personal computer capabilities have created increased demands on data base sources to supply information to households and business. Corresponding increases in data availability, storage,
20   retrieval and transmission capabilities have supported recent growth multi-media data presentation of information. Multi-media presentations include, in addition to conventional text, still-images, animation, slow and fast scan video, and graphics format visual

presentations. Multi-media also includes sound data presented in concert with, or independent of, one or more of the listed visual presentations. A multi-media presentation can range from the equivalent of an

5   electronic book including plain test in combination with still images to full motion video presentations of feature movies. Thus, multi-media spans a wide spectrum of data storage, retrieval and transmission requirements to present information in various formats

10   to system users.

As described, multi-media includes full motion video presentations. Various systems have been suggested to selectively provide a user with requested video programming. These systems are sometimes

15   referred to as programming-on-demand and impulse pay per view. Monslow et al. U.S. Patents Nos. 4,890,320 and 4,995,078, respectively issued December 26, 1989 and February 19, 1991. These patents disclose a television broadcast system for real-time transmission

20   of a viewer-chosen program at a viewer requested time to the requesting viewer's television receiver. The system comprises a program collection, which stores TV programs on a video tape. Each program is assigned and labeled with a catalog number.

25   A viewer request is transmitted using a conventional telephone over the PSTN to a scheduling computer. The chosen program is transmitted at the requested time over a broadband cable for viewing on the requesting viewer's television receiver. A control

30   unit prevents other households connected to the cable from viewing the program.

Cohen U.S. Patent No. 4,949,187 issued August 14, 1990 describes a video communication system comprising a remotely controlled central source of video and audio

data. This system allows home viewers to select from a
choice of movies or other video and audio data that may
be transmitted from the central source to be stored at
the viewer's premises. The viewer can play the
5   selection at any convenient time of his choosing. The
central source may store the data digitally. Movies
that need to be frequently accessed are stored on
disks. Movies that are accessed only infrequently are
archived. A distribution system CPU controls the
10   bidirectional flow of data from both types of drives.
Several movies can be transmitted simultaneously to
different users through a plurality of input/output
controllers. To make use of a single transmission
media, such as a telephone line, a multiplexer is used,
15   which may multiplex in the time domain or the frequency
domain.

        Etra U.S. Patent No. 5,012,334, issued April 30,
1991 discloses a video image bank for storing a
plurality of video image sequences. The bank provides
20   a visual effects set for video production. The bank
includes a library of video disks with an associated
library index. A microprocessor is loaded with the
library index. Groups of still frames, one from each
identified image sequence, are displayed and an
25   operator selects any one of the represented image
sequences for addition to an edit tape and associated
edit list prepared by the bank.

        Ciampa et al. U.S. Patent No. 4,635,136, issued
January 6, 1987 discloses a massive inventory of
30   labeled images, which are stored in a digital form. A
TV signal for each image is generated by a video
camera. Stored digital information defines the route
for a video camera to each site where a video image is
recorded.

Lambert U.S. Patent No. 4,381,522, issued April
26, 1983 discloses a cable television system which
includes a plurality of selectable video signal
sources having selectable television program material.
5   The system enables a viewer to select desired program
material available by telephone at a remote location
and have the selected material promptly available for
viewing. A minicomputer stores information on the
program source location, the status of the selected
10   program source, the available channels and the
schedules for each.

Walter et al. U.S. Patent No. 4,513,390, issued
April 23, 1985 discloses an information system for
storage, retrieval and generation of information from a
15   plurality of multi-media sources. The system uses a
plurality of source inputs and a plurality of data
outputs, all under the control of a common computer
that is operative along a common data bus. Included as
source inputs are stored memory data, hard copy,
20   microfiche and direct operator entered data.

Pocock et al. U.S. Patents Nos. 4,734,764 and
4,941,040, issued respectively on March 29, 1988 and
July 10, 1990 disclose cable TV systems for
distributing pre-recorded video and audio messages,
25   which comprise a remote storage device. The video is
presented as still frames, which are stored in a
multiple node frame store. A video frame has one of
the scan lines in its video blanking signal uniquely
addressed.

30   Nakajima et al. U.S. Patent No. 4,538,176, issued
August 27, 1985 discloses a video/audio transmission
system, which sends video and audio information from
video and audio files at a center to a subscriber

through at least one subcenter having a video/audio
buffer memory.

Walter U.S. Patent No. 4,506,387, issued March 19,
1985 discloses a programming-on-demand cable system,
which allows any one of a plurality of users to request
any one of a plurality of video programs from a library
of programs. The programs are stored in memory devices
selectable by a host computer at a central data station
in response to an address signal transmitted from the
user. Upon request of the viewers, the programs are
transmitted at a high non-real-time rate over a fiber
optic line network. Optical data is then reconverted
to electrical data and stored for broadcast to the
viewers.

McCalley et al. U.S. Patent No. 4,829,372, issued
May 9, 1989 discloses a presentation player which is
utilized in a digital, interactive communication
system accessible to a plurality of subscribers who can
select any of a plurality of pre-recorded video/audio
presentations for viewing on their TV sets. The system
includes a large scale data base, which stores digital
information including still frame images and textual
information in hard disk memory units.

Beaulier U.S. Patent No. 4,821,121, issued April
11, 1989 discloses a still image store system, which
stores and selectively outputs video image data. A
random access frame store receives input video data
converted into digital form and transfers the data to a
disk store for more permanent storage. Full size data
and reduced size data of the same video image are
stored.

Bohn U.S. Patent No. 4,888,638, issued December
19, 1989 discloses a marketing research system for
substituting stored TV programs for regularly

scheduled, broadcast TV programs. The substitute TV
programs may be transmitted from a central office via
telephone lines to households of cooperating panelists
for storage at the household premises.

5   While providing multiple data formats from a data
base to a user, these prior art systems do not
integrate network control functions to provide a high
speed data link between major nodes narrow band encoded
data from nodes to remote users. In particular, prior
10   art systems are not responsive to individual user
requests for providing high speed data connectivity
from a data source to a node serving one or more users
and selectively scheduling and supplying requesting
users with programming.

15   Related copending application serial number
07/766,535 filed September 27, 1991 describes Video-On-
Demand (VoD) Services that provide video programming to
subscribers over the public switched telephone network
(PSTN). A menu of video programming information is
20   accessible at the subscriber's premises. The
subscriber may transmit ordering information via the
PSTN to independent video information providers.
Video programming may be accessed and transmitted to
the subscriber directly from a video information
25   provider (VIP) or through a video buffer located at a
central office (CO) serving the subscriber.

The VIP transmits coded digital video data over
wideband PSTN supplied connectivity to a central
office. The video data may be buffered at the central
30   office for transmission over a POTS line to the
subscriber. A subscriber may use either a standard
telephone instrument over the PSTN or a dedicated
control device over an ISDN packet network to order the
video programming. Such a device is located at a

television set of the subscriber and permits a display
of the program menu on the television screen.

Connectivity between the central office and the
subscriber for transmission of video data is provided
by an asymmetrical digital subscriber line (ADSL)
system. ADSL interface units perform frequency
multiplexing of digital video information with voice
information to be transmitted to the subscriber and
support transmission on the ISDN packet data network of
a reverse control channel from the subscriber to the
central office.

However, the Video-on-Demand system does not
include an integral library of video program material,
nor does it support integration of several sources of
programming material to provide a multi-media or mixed
media presentation. The VoD buffer includes limited
storage capabilities for video and audio data supplied
by a VIP. Enhanced functionality is required to
support multiple program storage and to integrate data
from various data bases to provide composite
programming required for multi-media and mixed-media
presentations.

To support network management, a need further
exists for a system which dynamically interacts with
network facilities to reconfigure network resources in
real-time and in response to information requests. A
further need exists for a library system for accessing
and retrieving multi-media programming from storage and
from independent information providers in response to
user requests and transmitting the data over wide
bandwidth links to a node serving a user.

Accordingly, an object of the invention is to
provide a library of multi-media data including video
programming on demand using components of the PSTN.

Another object of the invention is to provide
subscriber access to multiple sources of combined image
and textual programming over the PSTN.

Still another object of the invention is to
5   provide real-time subscriber control of multi-media and
video programming delivery.

A still further object of the invention is to
provide a selected video program to a subscriber within
a predetermined short processing interval after
10   initiation of a request.

Disclosure of the Invention

According to one aspect of the invention, a media
server for supplying multimedia data includes a user
request processor responsive to a user request for
15   supplying information request data. A session
controller is responsive to the information request
data for supplying information retrieval data and
output control data. A data storage device is
responsive to the information retrieval data for
20   supplying program data. An output controller,
responsive to the output control data, supplies the
requested multimedia data. The multi-media data may
include text, still images, graphics, low and high
resolution partial and full motion video and audio.

25   The output controller includes transmission
circuitry for transmitting the multimedia data to
remote end users. According to a feature of the
invention, a public switched telephone network is
responsive to the output control data from the session
30   controller for supplying the multimedia data to remote
end users. The user request data is supplied to the
user request processor means by the public switched
telephone network.

According to another aspect of the invention, the
user request processor includes a transmission receiver
for receiving the user request data from a remote end
user.   The user request data is supplied to the
5   transmission receiver by a public switched telephone
network.

In accordance with another aspect of the
invention, the data storage device includes a plurality
of storage media for storing the program data.   The
10   data storage device may include both optical and
magnetic memories and may further include three
different storage media having substantially different
respective information retrieval times.

According to another aspect of the invention,
15   session manager includes an output port selector
responsive to the user request data for supplying
output port assignment data and a memory for storing
session status data.   The memory includes a table for
storing output port assignment data, input port
20   assignment data, and program status data.

According to another aspect of the invention, the
media server includes a program storage librarian
responsive to the information retrieval data for
supplying program priority data of respective program
25   data, the data storage device responsive to the
program priority data for storing the program data.

According to another aspect of the invention, a
random access storage unit provides storage of the
program data.

30   According to another aspect of the invention, a
program data input controller is responsive to the
session controller for supplying real-time program
data to the data storage device. A video data encoder
receives the real-time program data and supplies

encoded video program data to the data storage device and/or to the output controller for immediate distribution.

According to another aspect of the invention, the session controller includes session registers for storing dynamic frame location data indicating a current frame position of the program data. The session controller may further include a memory for storing a session routing table having program data routing data and program source data for active users.

According to another aspect of the invention, the session controller is responsive to user address and file selection data for supplying network configuration request data. The user request processor may include security processor for storing user access data and, responsive to the user access data, selectively supplying the information request data to the session controller.

According a feature of the invention, the user request processor can detect a user control link failure. The user request processor may further include an audio response unit for receiving the user request data and for supplying audio responses to a requesting user and a program catalog processor responsive to the user request data for supplying the program catalog data to a requesting user.

According to another aspect of the invention, the user request processor means supplies the user request data to a multi-media processing means for supplying information retrieval data to the data storage means.

The media file server system handles requests received from a Video Services Gateway and provides a video file feed to the customer via the network link. In addition to Video-on-Demand capability, the server

supports other user highly interactive multimedia
applications. The server is a file management system
responsible for inputting video files from video and
multimedia information provides storing these files or
5   passing the real-time data through to the user, keeping
track of the user's session, handling all interactive
control requests from the user, and controlling all
output to the user.

The system comprises an input controller, Q.931,
10   X.25, T1 and DS-3 interfaces, a librarian, a storage
manager, a session manager, an output controller, an
interactive processor, and a multi-media application
processor. The librarian provides file functions
including distribution of video, audio, stills, and
15   text selections to the session manager and the multi-
media application processor at the request of itself
and the multimedia application processor. The
librarian keeps track of the storage location of all
multimedia selections and catalogs and stores all
20   incoming files from VIPs. The librarian records access
history for determining statistical usage and trends.
This information is used for, among other things,
designating frequently used features for assignment to
rapid access highly addressable storage. Various
25   storage modules of differing capacity and access speed
are provided.

Storage format is MPEG encoded digital video,
received from the VIPs, or D1 digital video, which is
MPEG encoded by the server processor and stored in MPEG
30   format. The processor provides appropriate interface
with intelligent protocol.

The above and other objects, features and
advantages of the present invention will become

apparent from the following description taken in conjunction with the accompanying drawings.

Brief Description of Drawings

Figure 1 is a block diagram of a multi-media programming distribution system including a media server according to the invention integrated in a public switched telephone network.

Figure 2 is a simplified block diagram of a media server according to the invention.

Figure 3 is a detailed block diagram of a media server according to the invention.

Figure 4 is a block diagram of program storage facilities of the media server according to the invention.

Best Mode for Carrying out the Invention

The overall Video-on-Demand and Multi-Media distribution service platform shown in Figure 1 uses existing components of the Public Switched Telephone Network (PSTN). The system supports storage and distribution of conventional full motion video programs ("features") such as movies at user request, i.e., Video-on-Demand (VoD). Also supported are Multi-Media presentations and processing, including combinations of text, still images, and full and partial motion video. Video may include interactive activities such as training applications, games, shopping, etc.

The Media Server uses compression techniques to store video and other multi-media data in memory resources controlled by the Media Server for subsequent forwarding over interoffice facilities. The switching facilities are located in Central Offices (COs) serving residential customers or subscribers. Loop electronic

devices modify the transmission characteristics of the
local copper loop, to provide required enhancement to
the PSTN and permit delivery of full motion video
information and other media.

5   High data rate types of multi-media data are
encoded to conserve system resources. For example,
analog video information is first converted to a
digital format using encoding algorithms standardized
by the International Standards Organization (ISOs)
10   Motion Picture Experts Group (MPEG). Each title
comprises video information stored by the Media Server
as an addressable data file in conventional data
processing devices functioning as a video library. The
function of establishing and monitoring connections
15   linking a video library port transmitting selected
information with the end user ports receiving the
information is performed by a supervisory controller
such as a network control system, e.g., FLEXCOM
software, used to control the electronic digital cross-
20   connect switches (DCS) in the PSTN. The DCS, also used
for switching two-way DS-1 rate transmissions, is
adapted to additionally provide bridging or broadcast
of video information to several users. Data session
control between a video library port and a remote user
25   one of the functions performed by the session manager
of the Media Server.

       The network control software of the Media Server
in combination with management resources of the PSTN
(i.e., FLEXCOM/LINC or other Network Management System)
30   control the "network session" between an Output
Controller of the Media Server, external program
providers, and user ports. The session manager also
maintains a record of relevant data regarding each

session which is forwarded to a customer billing
system.

Customer local loops equipped with Asymmetric
Digital Subscriber Line (ADSL) devices are connected to
5   the DCS.   The multi-media distribution system provides
for the simultaneous transport of a one-way 1.544
megabit per second (MBPS) signal over the same twisted
pair transmitting voice messages to the residential
subscriber.   The ADSL transported signal is
10   demultiplexed and the 1.544 portion is then decoded
using MPEG standard techniques to deliver a full motion
video signal.   In the PSTN, fiberoptic technology will
replace existing coaxial and twisted pair connectivity
with corresponding enhancements made to switching and
15   routing equipment.

Referring to Figure 1, a multi-media system
includes CO equipment 10 which is part of a PSTN.   CO
10 provides connectivity from information providers 140
and 160 through the system to Media Servers 200 and 202
20   to Multi-Media subscriber 100 and VoD subscriber 120.

CO equipment 10 includes a conventional voice
switch 12 which includes means to detect off-hook,
service requests, call completion (i.e., ring trip), a
DTMF decoder 14 and dial pulse detector.   Voice switch
25   12 also includes an actual telephone call connection
switch for routing voice circuits among the various
ports.   The CO equipment shown may be physically
distributed over several sites.

Connected to voice switch 12 are ADSL equipment 16
30   and 18 for multiplexing (i) voice and signaling
information from voice switch 12 and (ii) digital
multi-media data from Digital Cross-Connect System
(DCS) 24 onto respective subscriber local loops 20 and
22.   Multi-media data from multi-media information

providers 140 and 160 is provided to DCS node 26 where it is selectively supplied to Media Server 200 or immediately transmitted to DCS node 24 under control of Network Management System 28.

In addition to providing pre-stored video and multi-media programming, the Media Server accepts video and multi-media programming from video and Multi-Media Information providers 140 and 160 for later transmission and for real-time and multi-pass MPEG encoding. Real-time encoding is used to provide encoded full motion video while minimizing network transmission requirements and providing a signal compatible with ADSL connectivity to subscriber premises 100 and 120. Multi-pass encoding performed by the Media Server provides a higher quality video signal for storage and later transmission over the network to subscriber premises 100 and 120.

ADSLs 16 and 18 multiplex data on subscribers loops 20 and 22 using frequency multiplexing, dividing the available loop bandwidth into three segments. Base band audio and signaling below 4 kilohertz (kHz) provides connectivity for a conventional telephone services available on the "plain old telephone system" (POTS). Alternatively, ISDN channel requirements consume the bottom 80 kHz of loop bandwidth. Reverse channel digital packet information is positioned between 80 and 90 kHz providing approximately 16 kilobits per second (kbps) connectivity from the subscriber premises to a packet switched network such as ISDN network over a D-channel interface. Compressed video and multi-media data is contained between 100 and 400 kHz to provide a 1.6 MBPS channel for transporting the video and multi-media data over respective loops 20 and 22 to customer premises 100 and 120.

The Media Server is shown in further detail in Figure 2. The Media Server system processes all requests from Video Gateway 30 for providing multi-media and video file feeds to customer premises via the
5 DCS and ADSL systems. The Media Server preforms input of video and other information files from Video Multi-Media Information providers 140 and 160, stores these files or passes real-time data through to subscribers 100 and 120, monitors and records user sessions,
10 processes all interactive control requests from users, and controls all output to the user.

The Media Server also processes and supplies multi-media services including interactive learning, interactive games, and other presentations. The Media
15 Server stores and processes all data required for the multi-media applications including text, still pictures, audio, and partial and full motion video, as well as interactive application scripts.

The Media Server includes eight major component
20 systems: Input Controller 210, Q.931 ISDN Interface 230, Librarian 250, Storage Manager 270, Session Manager 310, Output Controller 330, interactive processor 350 and multi-media application processor 370.
25 Input Controller 210 includes a plurality of DS-3 Input Ports 212 for receiving multi-media data including digitized video in the form of MPEG encoded digital video signals and unencoded video. D1 digital video is supplied to Librarian 250 for MPEG encoding.
30 Video supplied in MPEG encoded format is supplied to Session Manager 310 for storage by the Media Server or for immediate transmission by output controller 330.

Q.931 Interface 230 provides connectivity between Interactive Processor 350 and ISDN D Channel Interface

38 (Figure 1).   Interactive Processor 350 receives
command data over the ISDN from subscribers running
interactive programming from the Media Server.
Interactive programs include Multi-media presentations
5   and video games.   Interactive Processor 350 also
receives command data from subscriber control unit 130
for interactive control of feature presentations (i.e.,
conventional video programming including movies,
concerts, etc.) including pause, fast-forward, reverse,
10   and other "VCR" type capabilities supported by the
Media Server.   These latter commands are passed to
Session Manager 310 for further processing and control
of the video programming.

Data to be stored or retrieved from memory is
15   first routed through Librarian 250 and, under its
control, Storage Manager 270 either stores the program
data or retrieves and provides previously stored
program data to Output Processor 330.

Media Librarian 250 controls distribution of
20   video, audio, still image data and text selections to
Storage Manager 270 in response to information requests
from Session Manager 310 and Multi-Media Application
processor 370.

Referring to Figure 3, the Librarian further
25   monitors and record in Feature Index System 252 the
storage location of all video selections for VoD and
Multi-media applications. The Librarian also records a
history of access to video programming, i.e.,
."features", and to other data provided during each
30   twenty-four hour period in Usage Data Accumulation
System 260.   The usage data is supplied to Usage
Probability Processor 262 to establish an intelligent
cache using DRAM Storage 278 for rapid access and
highly addressable storage of features.

Feature Index System 252 maintain a catalog of
data and support processing for storing all locally
stored programs. This includes the allocation of
storage media type and space, maintenance of addressing
5   tables for program status and frame indices, and
maintain an index for all volumes. The program listing
data is supplied to a menuing system supported by Video
Gateway 30 (Fig. 1) via Packet Data Network 40.

Feature Index System 252 performs catalog
10   maintenance functions including input of new feature
program data into the system, ageing, and deletion or
archival of aged program data. New program data from
Video and Multi-Media Information Providers to be
stored by the Media Server are received via a DS-3 port
15   212 of Input Processor 210. The catalog maintenance
system determines the priority of the incoming program
data and allocates appropriate storage to the data.
Once the file space is allocated and the file is
stored, the volume indexes are updated, the frame
20   positions of the program are calculated and frame
addressing tables are created and stored. The frame
addressing tables are used to address a feature from
any position in the feature.

When it is determined that a stored feature is no
25   longer required, Media Librarian 250 removes the
program data from the file catalog. The record to be
deleted is then flagged by a system administrator of
Storage Allocation Processor 272.

Librarian 250 tracks frequency of feature access.
30   As a feature is requested less frequently, it is "aged"
by the Media Server. Usage Probability Processor 262
assigns a priority value to the feature which is used
to determine the appropriate storage type to maximize
system resources while providing acceptable access time

to the feature based on its demand history. Once a
feature is aged to a point of not having been requested
within a predetermined time period, the Media Server
removes the program from on-line storage units 278, 282

5   and 286 and places it in archival storage 290. The
feature header data remains stored in Feature Index
252, although access time for the feature will be
increased.

The catalog system updates feature titles data as

10   the features are loaded into the Media Server. The
updated catalog information is supplied by Librarian
250 of the Media Server to Video Gateway 30. The data
supplied to the Video Gateway is shown in Table 1.

ELEMENT	USE	ORIGIN	TYPE
Feature Title	To be used by the menu system to update the list of features provided for the users.	Video information provider or programmer	Alpha/Numeric
Feature Index Number	Used by the Gateway when transmitting a request to the server.	Librarian	Integer
Priority	Used by the Gateway to determine the set-up and wait time for a feature.	Originally determined by the feature box office ranking. Subsequently determined by the Trend processor.	
Feature Length	Used for schedule processing by the Gateway.		
Key Actor/Actress, Author, Director, Subject	Used by the Gateway for performing searches on the elements listed.	VIP	Array
Motion Picture Association Rating	Used by the Gateway for feature type blocking based on rating: G, PG, PG-13, R, NC-17, XXX	VIP	
Category	Used by the Gateway Menu processor to determine the placement of the title.	VIP	

TABLE 1

Alternatively, according to a preferred embodiment of the invention, menu data is retained in the Media Server and downloaded to user customer provided equipment (CPE) for viewing and selection or transmittal to the user directly for processing.

Usage Probability Processor 262 statistically determines features having the highest probability of usage on a per hour and day of week basis to properly allocate high order storage, i.e., DRAM Storage 278, on an hourly basis. In support of this function, Usage Data Accumulation Memory 260 stores tables of data including time of viewing, day of viewing and cumulative number of requests that are updated each time a feature is supplied.

Allocation of storage in the Media Server is based on the ranking of a feature and the output of the trend processing performed by Usage Probability Processor 262. Referring to Fig. 4, storage is divided into several components, including DRAM 278, Magnetic Tape 290. All features are stored on the appropriate media based on the priority ranking of the feature. For example, DRAM Storage 278 is used for the highest priority features as determined by the trend processing whereas Archival storage is used for the lowest priority features. Table 2 gives typical priority assignments and storage capabilities of each media.

PRIORITY	NUMBER OF FEATURES	STORAGE
1	20 ± 5	DRAM
2	100 ± 3-	MAGNETIC DISK
3	300 ± 50	HIGH SPEED TAPE
4	500 +	ARCHIVAL TAPE

TABLE 2

DRAM Storage 278 is used for the highest twenty features and data files as determined by the trend processing. When a feature or other high priority media file is stored in DRAM it does not occupy magnetic storage space until removed from DRAM storage. A compressed feature length movie of 90 minutes duration occupies approximately 1.2 gigabytes of DRAM storage.

Disk Storage Units 282 are fast access magnetic and/or optical media providing storage for the second highest fifty priority features and media data files as determined by the trend processing. When a feature is stored on a Disk unit, it does not occupy DRAM or Tape Storage until removed.

High Speed Tape Storage Units 286 store features and multi media data files having a medium priority as determined by the trend processing. Finally, Archival Tape Storage is used for the lowest priority features and media data files.

Storage Channel Management Processor 274 controls flow of data between all storage devices and Output Control Processor 330. Input Control Processor 210 receives multi-media and feature program data from Video and Multi-Media Information Providers 140 and 160. Feature data input streams are accepted either as MPEG encoded digital video or as D1 digital video to be encoded by the Media Server. All data is either stored for play at a users request or passed directly through to the user as real-time programming.

MPEG encoded video data received at DS-3 port 212 of Input Processor 210 is routed to Session Supervisor

312 for storage by the Media Server or as flow-through
to an appropriate output port 332 of Output Processor
330. Session Manager 310 supervises the data flow once
connection from the Video Multi-Media Information
Provider to the subscriber is established by Input
Control Processor 210 and Output Processor 330. No
data is stored and no index information is supplied to
Librarian 250 in the case of flow-through data.

For non-encoded data, a simplified form of MPEG
encoding is performed by Real-Time MPEG Encoder 390,
requiring a latency of approximately ten minutes from
data input to data output. Multi-Pass MPEG Encoder 392
is used for non-real-time processing, and provides full
MPEG encoding of video data. Both MPEG encoders
receive non-encoded video data from Input Processor 210
and provide encoded video to Storage Allocation
Processor 272 of Storage Manager 270. The encoded
video data is either stored in an appropriate storage
media or transmitted by Storage Channel Management
Controller 276 to Output Controller 310 for
transmission to a subscriber over the PSTN.

Session Manger 310 include Session Supervisor 312
which manages all program sessions including system
access by Video-on-Demand subscribers, other Multi-
media users and input and output to, from and through
the Media server by Multi-Media Information Providers.
Session Supervisor 312 tracks and records all data
pertinent to each session including output port, input
port (if receiving data directly from a Multi-media
Information Provider or if the user is a Multi-media
Information Provider), feature being played or Multi-
media application address, feature index data, feature
frame data, and session condition. The Session
Supervisor also performs network resource optimization

by the simultaneous broadcast of the same feature over one output port to multiple subscribers. However, each subscriber session is individually managed to permit interactive features such as video pause.

5   Session Trace Processor 314 tracks each subscriber's session based on feature and frame so that the execution of a pause sequence can be managed for each individual session. A subscriber may start viewing a feature as part of a larger group, with a

10   subsequent selection of a pause function placing the subscriber "out of sync" with the rest of the group. Once out of sync, a separate session is established for that user requiring Session Manager 310 to cause the Gateway to establish a new network link to the

15   subscriber's viewing location. Note that, although each user is assigned an individual logical session, sessions remaining in sync with each other share output and network facilities.

Session Supervisor 312 maintains a matrix of

20   routing information for each session, including what users are assigned to a given output port, and the source of the input data: Input Port number or local storage location in use. A file play clock uses the total number of frames in a given feature to estimate,

25   by time, the frame position for that feature. This data is provided to the Session Registers 316 for tracking frames for each logical subscriber session and is used to restart an interrupted session. Session Supervisor 312 discontinues register updates upon

30   detection of a session interruption. The Session Manger 312 receives requests for initial session establishment and for file retrieval from Gateway 30 via Q.931 Interface 230 and Control Channel Filter 354.

Interactive Processor 350 processes incoming
commands from subscribers sites once a session is
established by the Gateway. These commands include
pause or like feature for Video-on-Demand, and all
5   response and requests by Multi-Media work stations.
The incoming data is interrogated for content and
selectively forwarded to the appropriate module for
processing: Session Manager 310 for Video-on-Demand and
other retrieval applications and to Multi-Media
10   Application Processor 370 for Multi-Media Applications.

Control Channel Monitor 352 monitors each
subscriber's control channel to detect a communication
failure. In the event of a failure, Session Manager
310 is informed and corrective action is initiated.

15   Referring to Fig. 1, dial-up access to the Media
Server in the absence of dedicated Control Unit 130 is
provided by voice switch 12 which establishes
connectivity with VRU 34 which answers the incoming
call. The VRU prompts the subscriber for a user ID
20   which is input via the DTMF pad of telephone instrument
122. The user ID is checked and, if valid, the VRU
prompts for a video selection. The video selection is
then input using the DTMF pad of telephone instrument
102 which then sends the selection information to the
25   Media Server via Video Gateway 32 and Packet Data
Network 40. The Media Server identifies the requested
title and determines if the title is available.

If the title is found, and has not been previously
queued for transmission, the corresponding data file
30   is opened and a reserve idle communications port is
identified for transmission of the video data to an
associated DCS node 24 or 26. Transmission of the data
is delayed for a predetermined number of minutes in
response to a first request for the video selection to

allow for simultaneous transmission of the video data
file to subsequent subscribers placing an order for the
same title within the delay period. The subsequent
request orders are also placed in the queue and the
5   associated communications port ID is matched to the
subscriber's network address.

After expiration of the predetermined delay, i.e.,
when current time equals the designated start time, the
video data file is transmitted from Media Server
10   through the DCS to the designated ADSL interface 18
for transmission to subscriber premises 120. At the
end of the program, a message is transmitted by the
Media Server to Network Management System 28 to take
the system down by terminating DCS connectivity.

15   In an enhanced version of the Video-on-Demand
system, subscriber premises 120 (Figure 1) is provided
with a control unit 130 for receiving data commands
from remote control 132. Remote control 132 can be a
conventional infrared remote control for interacting
20   with control unit 130. Data from control unit 130 is
provided to subscriber ADSL interface 124 for
transmission of command data to ISDN D-channel
interface 38. The ISDN D-channel interface can provide
initial subscriber order information directly to video
25   gateway 30 in lieu of using voice response unit 34.
Once video gateway 32 identifies a subscriber request
to establish connectivity with the Media Server, the
address of control unit 130 is provided to the
Interactive Processor 350 (Fig. 3). Upon receipt of
30   the corresponding Interactive Processor network address
by control unit 130, direct connectivity is established
between control unit and the Media Server 200 or 202
over packet data network 40. This connectivity permits
direct data transfer between the customer premises and

the Media Server to support interactive video control
used in interactive educational programming and
interactive video presentations such as video games.

Control unit 130 also supports interactive control

5   of the buffered video data by transmitting appropriate
commands to Session Manager 310. These controls allow
the subscriber to fast forward, rewind, forward,
reverse search and pause the video/audio data provided
via DCS 24 to the subscribers premises.

10   VRU 34 may additionally include voice recognition
capability to support voice recognition security
functions and voice selection of video programming.

Although the present invention has been described
and illustrated in detail, it is clearly understood

15   that the same is by way of illustration an example and
is not to be taken by way of limitation, the spirit and.
scope of the present invention being limited only by
terms of the appended claims. For example, MPEG
encoding may be performed by an attached processor that
is part of the server architecture. Further, each
component of the server architecture may reside on a
separate processing platform and be closely coupled by
high speed application program interfaces (APIs).

Claims

1. A media server for supplying multimedia data, comprising:

means for processing user request data, said user request processing means being responsive to user
5 request data for supplying information request data;

means for controlling sessions of said media server, said session control means being responsive to said information request data for supplying information retrieval data and output control data;

10 data storage means responsive to said information retrieval data for supplying program data; and

means for controlling the output of said media server, said output control means being responsive to said output control data for supplying said multimedia
15 data.

2. The media server according to claim 1 wherein said output control means comprises transmitting means for transmitting said multimedia data to remote end users.

3. The media server according to claim 1 further comprising a public switched telephone network responsive to said output control data from said session control means for supplying said multimedia
5 data to remote end users.

4. The media server according to claim 3 wherein said user request data is supplied to said user request processing means by said public switched telephone network.

5.   The media server according to claim 1 wherein said user request processing means comprises transmission receiving means for receiving said user request data from a remote end user.

6.   The media server according to claim 5 further comprising a public switched telephone network for supplying said user request data from a remote end user to said transmission receiving means.

7.   The media server according to claim 1 wherein said data storage means includes a plurality of storage media for storing said program data.

8.   The media server according to claim 7 wherein said data storage means includes optical storage means and magnetic storage means.

9.   The media server according to claim 7 wherein said data storage means includes three different storage media having substantially different respective information retrieval times.

10.   The media server according to claim 1 wherein said session management means includes:
     output port selection means responsive to said user request data for supplying output port assignment
5   data; and
     memory means storing session status data.

11.   The media server according to claim 10 wherein said memory means of said session management means includes table means storing output port

assignment data, input port assignment data, and
5   program status data.

     12. The media server according to claim 1 further
comprising program storage librarian means responsive
to said information retrieval data for supplying
program priority data of respective program data, said
5   data storage means responsive to said program priority
data for storing said program data.

     13. The media server according to claim 1 further
comprising a random access storage unit for storing
said program data.

     14. The media server according to claim 1 further
comprising program data input control means responsive
to said session control means for supplying real-time
program data to said data storage means.

     15. The media server according to claim 14
further comprising video data encoding means receiving
said real-time program data and supplying encoded video
program data to said data storage means.

     16. The media server according to claim 14
further comprising video data encoding means receiving
said real-time program data and supplying encoded video
program data to said output control means.

     17. The media server according to claim 1 wherein
said session control means includes session register
means storing dynamic frame location data indicating a
current frame position of said program data.

18. The media server according to claim 1 wherein said session control means includes memory means storing a session routing table having program data routing data and program source data for respective
5   active users.

19. The media server according to claim 1 wherein said session control means is responsive to user address and file selection data for supplying network configuration request data.

20. The media server according to claim 1 wherein said user request processing means includes security means storing user access data and, responsive to said user access data, selectively supplies said information
5   request data to said session control means.

21. The media server according to claim 1 wherein said user request processing means includes means for detecting a user control link failure.

22. The media server according to claim 1 wherein said user request processing means includes an audio response unit for receiving said user request data and for supplying audio responses to a requesting user.

23. The media server according to claim 1 wherein said user request processing means includes program catalog data storage means responsive to said user request data for supplying said program catalog data to
5   a requesting user.

24. The media server according to claim 1 further including a multi-media application processor, said

user request processing means supplying said user
request data to said multi-media processing means and,
5   in response, said multi-media processing means
supplying said information retrieval data to said data
storage means.

25.   In a public switched telephone network (PSTN)
for providing multi-media data to one of a plurality of
subscriber premises, including a cross-connect system
responsive to control data for establishing
5   connectivity between a multi-media data base and said
subscriber premises, the improvement comprising:
a media server for supplying said control data and
supplying said multimedia data, including
(i) means for processing user request data, said
10 user request processing means responsive to user
request data from the PSTN for supplying information
request data,
(ii) means for controlling sessions of said media
server, said session control means being responsive to
15 said information request data for supplying the control
data to the cross-connect system and supplying
information retrieval data, and
(iii) a multi-media data base responsive to said
information retrieval data for supplying the multimedia
20 data to remote end users.

26.   A media server for supplying full motion
video data, comprising:
means for processing user request data, said user
request processing means being responsive to user
5   request data for supplying information request data;
means for controlling sessions of said media
server, said session control means being responsive to

said information request data for supplying information
retrieval data and output control data;

10   data storage means responsive to said information
retrieval data for supplying program data; and

means for controlling the output of said media
server, said output control means being responsive to
said output control data for supplying said full motion

15   video data.
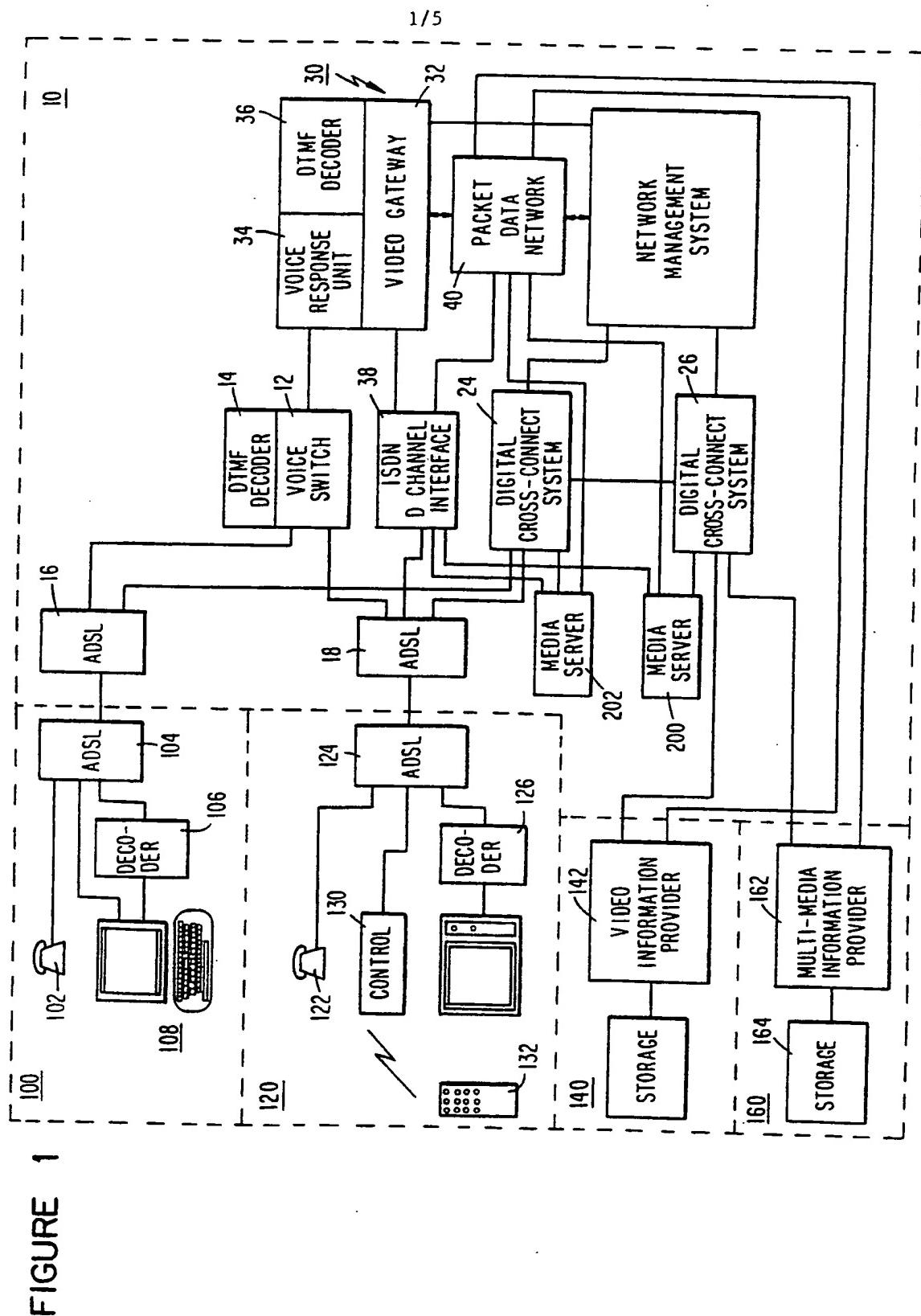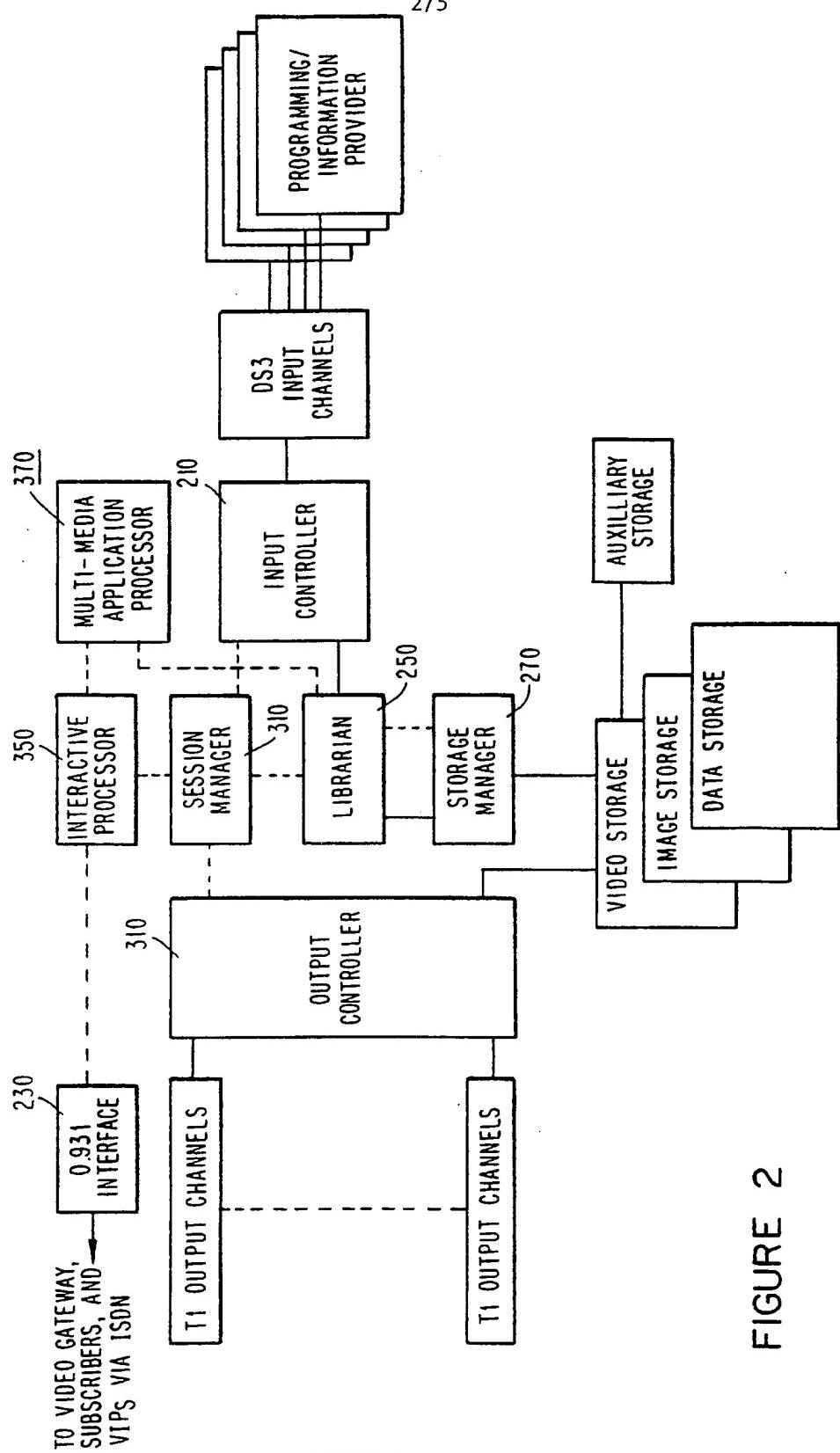
1/5

FIGURE 1

2/5

PROGRAMMING/ INFORMATION PROVIDER

DS3 INPUT CHANNELS

MULTI-MEDIA APPLICATION PROCESSOR 370

INPUT CONTROLLER 210

INTERACTIVE PROCESSOR 350

SESSION MANAGER 310

LIBRARIAN 250

STORAGE MANAGER 270

AUXILLIARY STORAGE

VIDEO STORAGE

IMAGE STORAGE

DATA STORAGE

OUTPUT CONTROLLER 310

Q.931 INTERFACE 230

T1 OUTPUT CHANNELS

T1 OUTPUT CHANNELS

TO VIDEO GATEWAY, SUBSCRIBERS, AND VIPs VIA ISDN
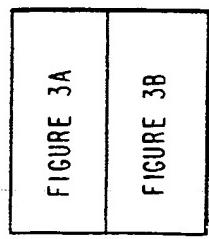
FIGURE 2
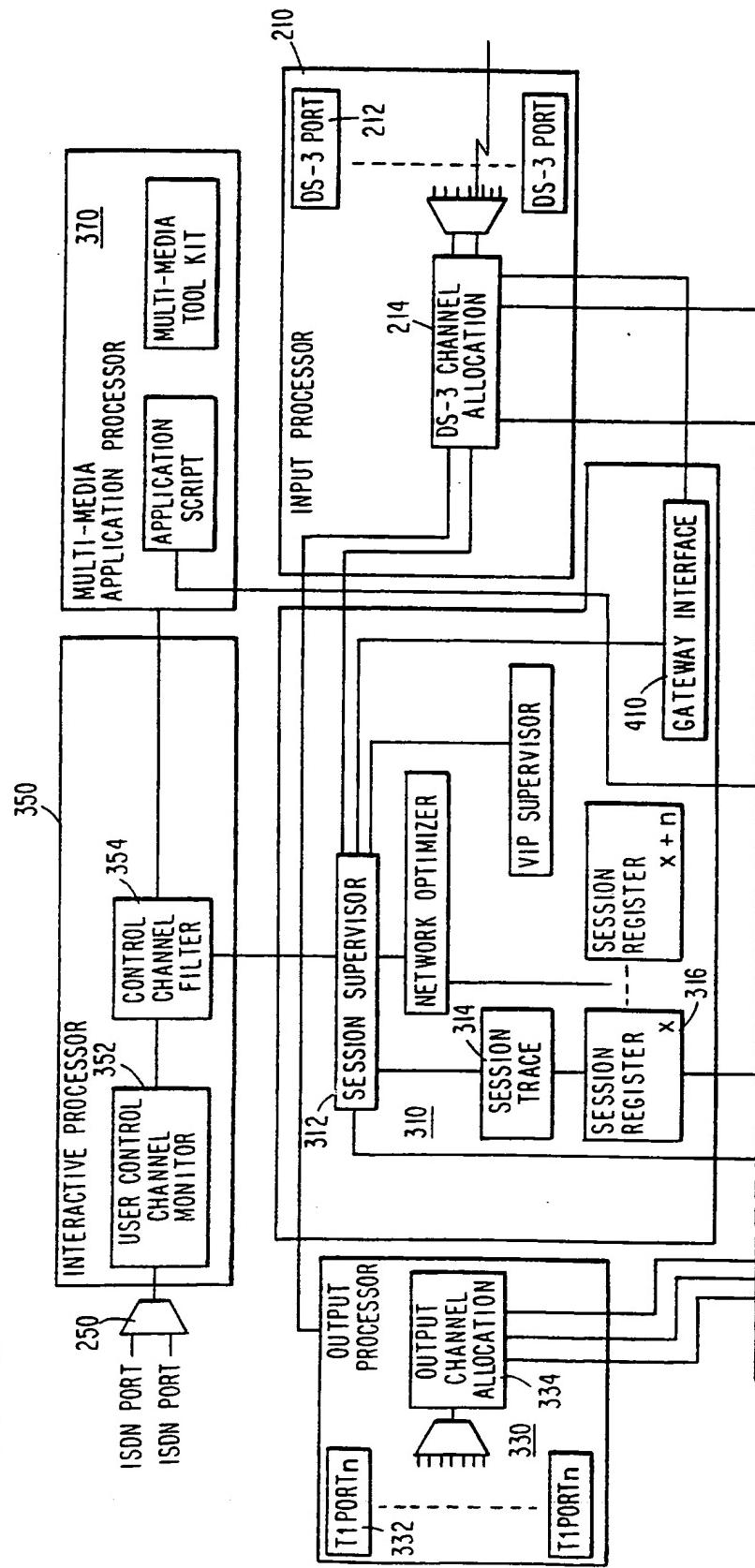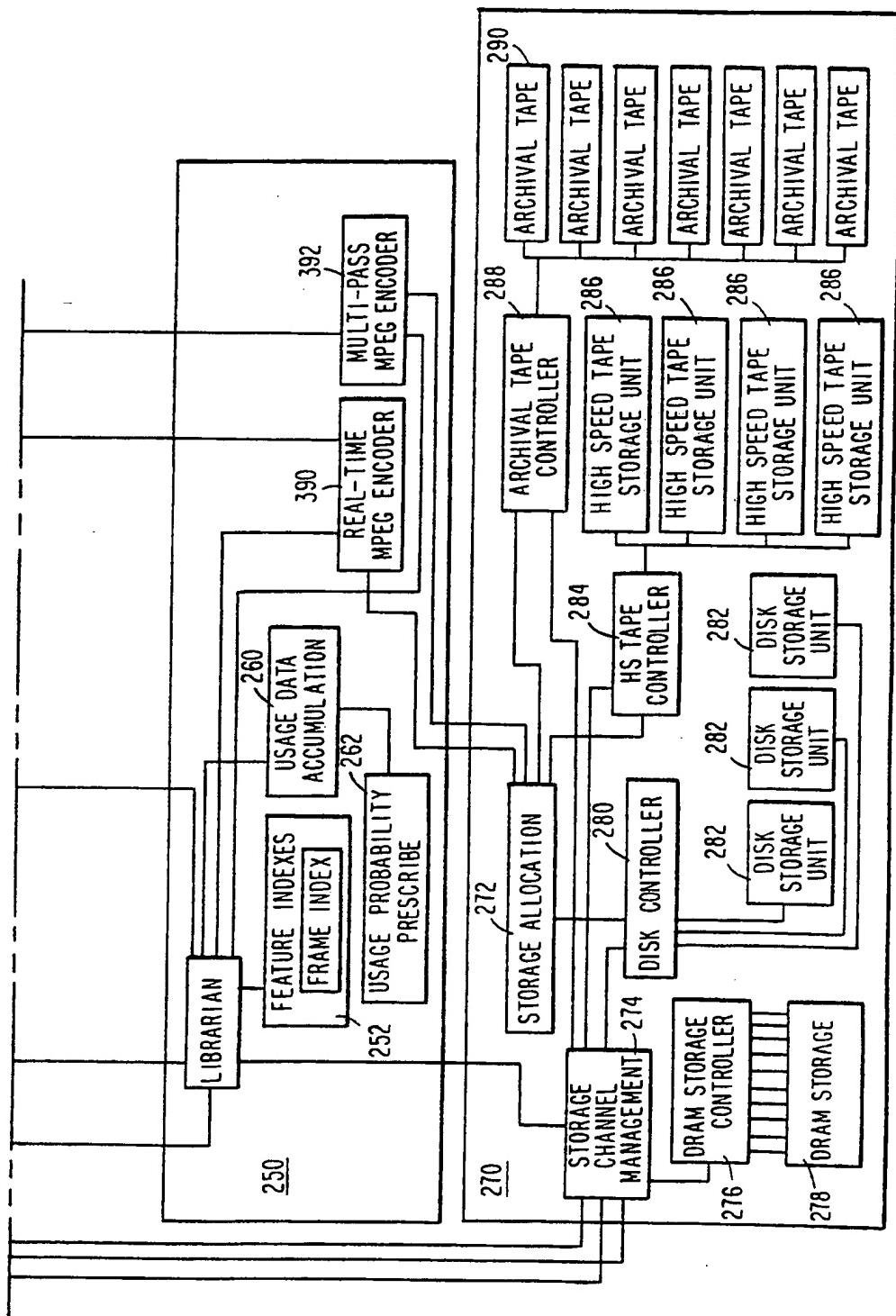
FIGURE 3A
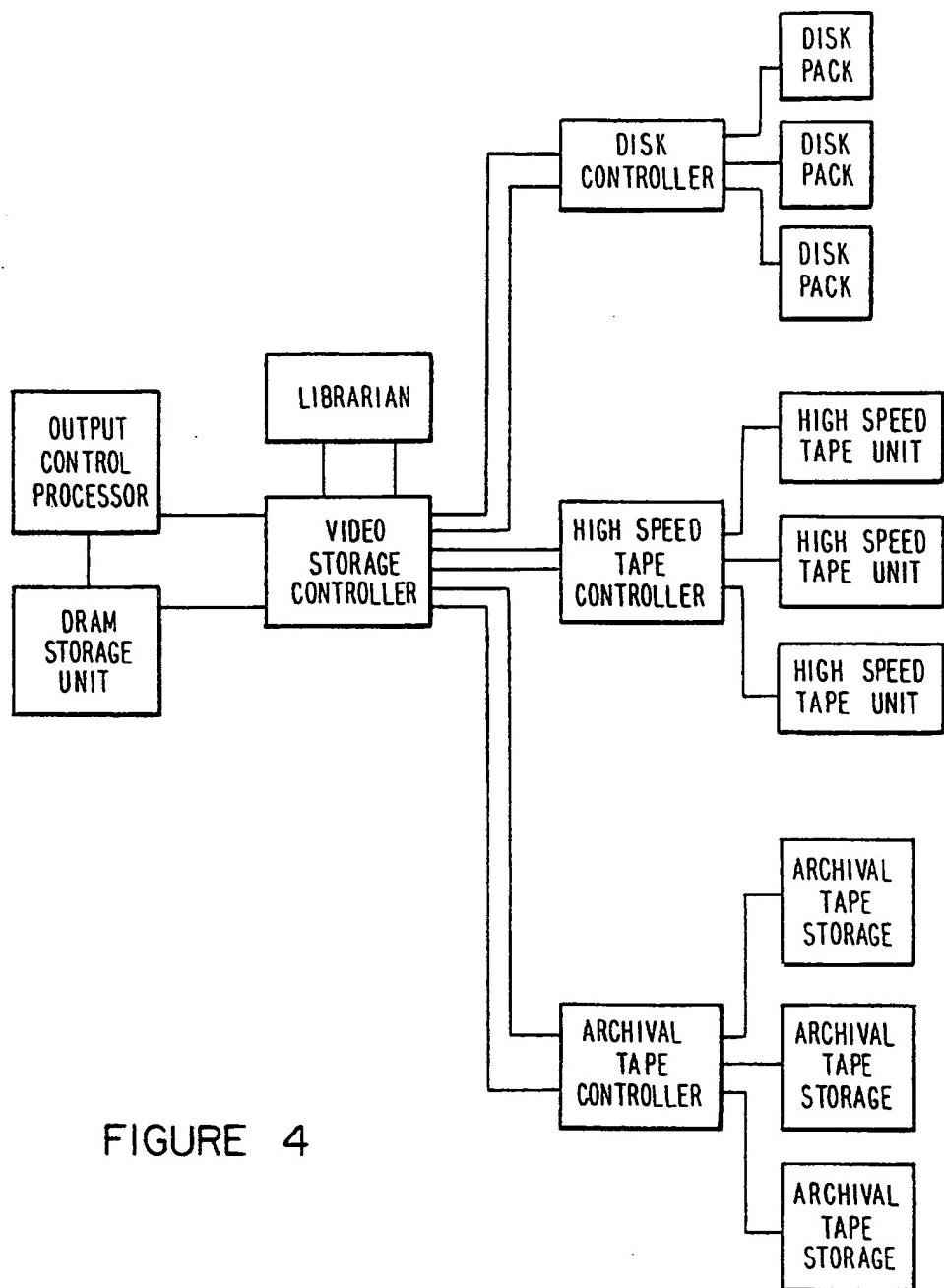
FIGURE 3

| FIGURE 3A |
|-----------|
| FIGURE 3B |

FIGURE 3B

FIGURE 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US93/05982

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :H04N 1/00, 7/00, 7/10, 7/14; H04M 11/00
US CL :358/84, 85, 86; 379/93, 96, 97, 98, 100

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 358/84, 85, 86; 379/93, 96, 97, 98, 100

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, A, 5,027,400 (Baji et al) 25 June 1991, see the entire document.	1-26
A	US, A, 4,972,462 (Shibata) 20 November 1990, col. 5, line 60 through col. 9, line 51.	1-8,13-17, 19, 20, 22-25
A	US, A, 4,518,989 (Yabiki et al) 21 May 1985, col. 2, line 5 via col. 5 line 22.	1, 2, 4-8, 13, 19, 22-26

☐ Further documents are listed in the continuation of Box C.   ☐ See patent family annex.

* Special categories of cited documents:

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 AUGUST 1993	01 SEP 1993

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